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ACQUIRING NEEDED SATELLITE COMMUNICATIONS:

THE NEED TO BETTER BALANCE MILITARY AND COMMERCIAL

By

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A Research Report to the Faculty

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BIOGRAPHY

Lieutenant Colonel Jeffrey R. Granger was commissioned in the United States Air Force through the Air Force Officer Training School in July 1993, after serving 7 years as an Air Force enlisted communications-computer systems programmer. As a Lieutenant and computer systems analyst at Scott Air Force Base, he deployed to King Abdul Aziz Air Base, Dhahran, Saudi Arabia from December 1995 to March 1996 in support of Operation SOUTHERN WATCH. In 1997, Lieutenant Colonel Granger transferred from Scott Air Force Base to Cheyenne Mountain Air Force Station, Colorado and assumed duties as officer in charge of intelligence systems operations for North American Air Defense Command and United States Space Command. He moved on to Yokota Air Base, Japan, in November 2000 where he commanded the communication squadron's information systems flight and served as the airlift wing's executive officer. Lieutenant Colonel Granger left Japan for assignment as a program manager for Air Mobility Command's network operations, returning to Scott Air Force Base in July 2003. In July 2005, he became a student of Air Command and Staff College, Maxwell Air Force Base, Alabama, graduating in June 2006. This was immediately followed by his tour as Commander of the communications squadron at Columbus Air Force Base, Mississippi. Following command, Lieutenant Colonel Granger completed a 1-year deployment as Chief of Communications Operations and Engineering for US Air Forces Central - Forward before returning to Maxwell Air Force Base as a student of Air War College in 2009.

INTRODUCTION

"If you don't have space assets today there is immediate impact on our ability to fight in irregular warfare, near peer competition, homeland defense, crisis response, and global assessment. All of which are important if you remember that the question before the question is what's my satellite coverage."

- *General C. Robert Kehler*[1]
  Commander, Air Force Space Command
  20 November 2009 speech

Combat operations today demand the movement of vast amounts of information to see the enemy, track the enemy, command and control forces, support forces, and take the operational picture to US decision makers in all branches and at all levels. These requirements make satellite communications essential and, in the current environment, in extremely high demand. The cumulative size of all the communications paths, a measure expressed colloquially as bandwidth, is not enough to meet the needs. Regarding planning and executing operations in Afghanistan and Iraq, one perspective was "planners still spoke in terms of megabits per second, [while] forces in the field needed gigabits per second."[2] For these operations, satellite communications are vital. Satellites provide a considerable amount of the bandwidth sought by warfighters, especially in many of the remote, infrastructure deficient regions in which the nation employs combat forces today. Past research assessed the imperative of military capability and articulated the importance of satellite communications to situational awareness, command, and control of forces. The conclusion was the more expeditionary the services become, the more severe the negative impact will be if satellite communications are lost.[3]

The position of this paper is the US Air Force needs additional military satellite communications to meet demands and mitigate risks. This paper will look at the current environment and discuss the problems the US Air Force and Department of Defense (DoD) face in providing communications to the warfighter. One factor is that the US Air Force, with a

limited amount of military satellite bandwidth, has built a dependence upon commercial communications satellites. There is a significant risk if one accepts current reports indicating the US military obtains 80% of its bandwidth from commercial providers.[4] Commercial capability comes with great expense and unique risks that the US military can mitigate with more military owned and operated satellite communications. The demand for bandwidth is great and continues to grow. DoD and US Air Force decision makers must concern themselves with making smart investment decisions that best meet demands considering the different risks and constraints. Success lies in establishing the right balance between military owned and commercially provided capability.

Regardless of whether the US Air Force meets communications requirements via commercial or military capabilities, there is risk. Space systems are subject to the perils of the space environment, to include other space objects. Space systems, commercial or military, are subject to physical or cyber attacks from adversaries. Commercial satellite system companies must also fend off competitors. To ensure profits and viability, commercial companies must make business decisions that could impact current support to the US military. The US space industry maintains a competitive advantage now, but there are growing concerns of a shrinking advantage.[5] Having more military satellite communications to better balance the use of commercial satellite communications is necessary in the contested environment of space. Military owned and operated capability allows for direct implementation of physical and cyber security measures, and reduces the problems of commercial business decisions that may not address security or move capability away from US military operations. Other companies and technologies can provide alternatives to satellite communications; however, these other methods

have their own set of limitations and risks, and any course of action will require investment and resources.

Another aspect contested "environment" is resources. The US military has invested, and plans to invest, billions of dollars in space capability. According to *Futron's 2009 Space Competitiveness Index*, the US government spent 66 and one half billion dollars on space in 2008. This investment was across all segments of space capability, to include satellite systems, launch systems, support systems, in both the military and civilian space programs. The DoD garnered roughly 26 billion dollars. Satellite communications is the significant driver of satellite development in both the military and commercial sectors.[6] The US military is looking to commercial satellite communications capability, with estimations of about one half billion dollars to commercial companies for leased bandwidth.[7] US Air Force planners and decision makers must take into account constrained and decreasing resources as well as the dangers in space as they address capability. Current plans, processes, and practices used to meet bandwidth needs appear to be falling short on both meeting demand and mitigating risk.

ASSESSING NEEDS

One can begin to understand the scale of the demand by comparing the satellite bandwidth usage of warfighters in Operation DESERT STORM to today's operations. Operation DESERT STORM, the operation to liberate Kuwait from Iraq's Saddam Hussein, was characterized as the first "space war," because of the significant test and use of space systems for operations. The US military used satellites for intelligence, communications, navigation, and weapons guidance.[8] In current operations in Iraq and Afghanistan, there is a large amount of bandwidth supporting computer networks, voice networks, remotely piloted vehicle operations, still and full-motion video from a multitude of platforms, air traffic control, news and television feeds, video teleconferencing, and many other necessary services. According to one source, the rate of satellite usage to support combat operations has increased from 140 bits per second per deployed member during Operation DESERT STORM to 13,800 bits per second per deployed member during Operations ENDURING FREEDOM and IRAQI FREEDOM--a 9,700 percent increase.[9]

Lacking its own organic capability to support that demand, the US military and other participating nations have turned to commercial satellite communications providers for capability. There has been a complete reversal of the ratio of military-provided bandwidth to commercially provided bandwidth between Operation DESERT STORM and current operations in Iraq and Afghanistan (Figure 1). Multiple authoritative sources corroborate that the commercial sector provides 80% of bandwidth used in Operations ENDURING FREEDOM and IRAQI FREEDOM.[10] If the demand for capability continues to grow, the US Air Force will need to seek even more commercially available capability, further increasing commercial dependence.

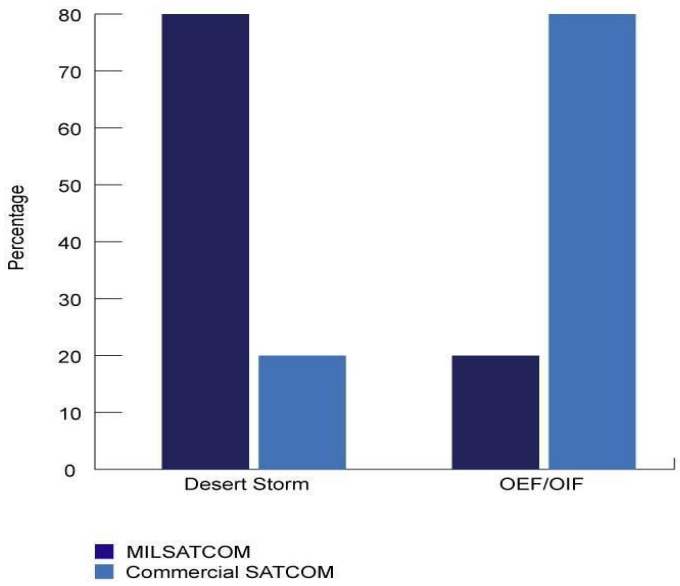

Figure 1. Ratio of Military Satellite Communications to Commercial Satellite Communications in DESERT STORM versus ENDURING FREEDOM/ IRAQI FREEDOM. (Reprinted from briefing, David Cavossa, Satellite Industry Association, subject: Satellite Industry Overview and Lessons Learned, 26 September 2007)[11]

Dependence on commercial satellite communications providers raises some concerns. Driven by profit margin, vendors could move satellites covering one region of the globe to a position covering a completely different region of the globe, where those vendors forecast increased profits, regardless of military need. Additionally, customers currently compete for the limited satellite communications bandwidth available. The vice president of the largest US commercial satellite communications provider provided a perspective that, even though the US Government is the single largest customer, they are "only 12 percent of Intelsat's total business.... We have customers who are willing to pay top dollar and make long-term commitments."[12] There is growing concern that the increasing demands and competition for capability will drive the cost for services higher. If the business of acquiring commercial

capability proves too costly for US Air Force budgets, it is unclear where the US Air Force could turn for capability, resulting in risk to operations.

One of the most frightening operational risks for the US Air Force is realized if one of the commercial satellites current operations depend on is destroyed--either via the forces of nature or via an adversary. Though not directed at the US military, an attack on a commercial satellite could be as damaging as an attack directly on a US military satellite. In 1998, the loss of the Galaxy 4 satellite disrupted communications and some banking services across the US.[13] In 2005, Intelsat 804 failed, damaging communications in the Pacific region, causing a near total loss of communications for American Samoa.[14] A loss of commercial capability in use by the US Air Force can result in loss of aircraft or loss of life. The news media has raised public concern regarding the "escalating costs, risks, and widespread uncertainty" of commercial satellite communications providers.[15] Even if stable, what would be the US position or recourse if one of the foreign owned and operated satellites the US military is depending on is attacked? The US has yet to define a policy to address that potential event. Yet, indications are the need to access commercial providers will grow considerably as the demands for bandwidth continue to increase, escalating US dependence on commercial providers, some likely foreign, complicating risk mitigation and defense strategies.

The demand for bandwidth and the need for additional satellite communications will continue to increase. Changing military activities, surges in the number of personnel supporting global operations, and technology demands appear continuous. Even as forces draw down in conflict environments, this author and another knowledgeable researcher expect the number of remotely piloted vehicles (RPVs) to rise.[16] In Iraq and Afghanistan, there has been a continuous rise in the types, numbers, and countries requiring RPV capability, and there is a concerted push

for more RPVs coming from the Secretary of Defense. Of particular importance to this growing fleet of aircraft is the need for satellite communications, used for command and control of the platform and operation of the capability on board the platform once launched and beyond line-of-sight control from the ground. With this comes increased bandwidth demands to move the required video feeds and expanded computer network capability. The US Government Accountability Office (GAO) highlighted the concern with these increasing vehicle communications requirements, in conjunction with other increasing requirements.

> As the number of UAVs* grows, the systems will have to compete for more room on the [electromagnetic frequency] spectrum. Spectrum resources are scarce and facing increased demands from sources other than UAVs. Because of the changing nature of warfighting, more and more military systems are coming to depend on the spectrum to guide precision weapons and obtain information superiority. Recently, because of advances in commercial technology, a competition for scarce frequency spectrum has developed between government and nongovernment users.[17]
>
> **(UAVs, unmanned aerial vehicles, is the former descriptor for what are now identified as RPVs)*

Satellite communications is the critical capability using the electromagnetic frequency spectrum the US GAO discusses. If the RPV industry delivers 13,000 vehicles in the next five years, as one industry focused author suggests,[18] the competition for supporting satellite communications will increase dramatically.

The necessary expansion of coalition networks to support this change and continuing centralization of command and control are driving bandwidth increases. Senior military leaders receive their situational awareness and provide guidance from locations outside of combat environments via satellite communications. The RAND Corporation presented a graphical representation of expected growth in bandwidth needs based on information from the former United States Space Command (Figure 2). This information supports the GOA concerns noted

above regarding needs over and above RPVs. The RAND perspective is that US military needs, even the day-to-day operational needs outside of combat, will continue to increase.

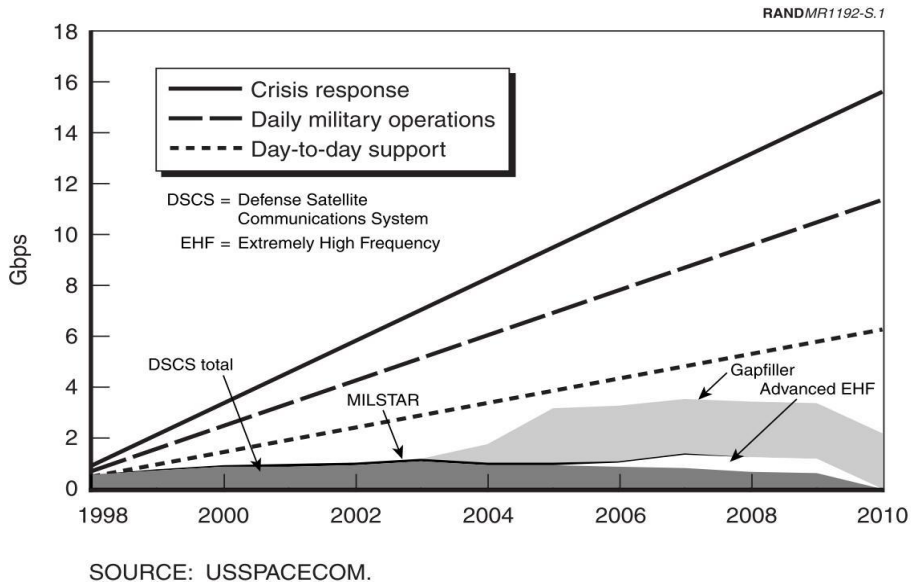

Figure 2. Department of Defense Satellite Communications Requirements Projection. (Reprinted from Tim Bonds, et al., *Wideband Investment Options for the Department of Defense*, 111)[19]

The US Air Force must look at how sufficient current plans are for meeting this increasing demand. The US Air Force and the other services manage a number of important satellite programs, but of significant concern is the ability of these programs to overcome the lack of organic military satellite communications. Figure 2 above provides some indication of the limits of current and planned military satellite communications capability to meet requirements. Some commercial satellite professionals agree with this assessment. A prominent member of the Space Industry Association has looked at the past and future military bandwidth requirements and made the same conclusion that, given current military communications satellite programs and plans, demand will never be met (Figure 3). If the current plans will not support demands, then the US Air Force must look at options for getting the best force mix with the scarce resources available.

Commercially provided capability will likely be a part of any future, but when assessing options, planners must consider the value of military owned and operated capability. Military satellite communications affords for needed physical and cyber security of capabilities and reduces the risks of commercial business decisions and any unsteady economic turns.

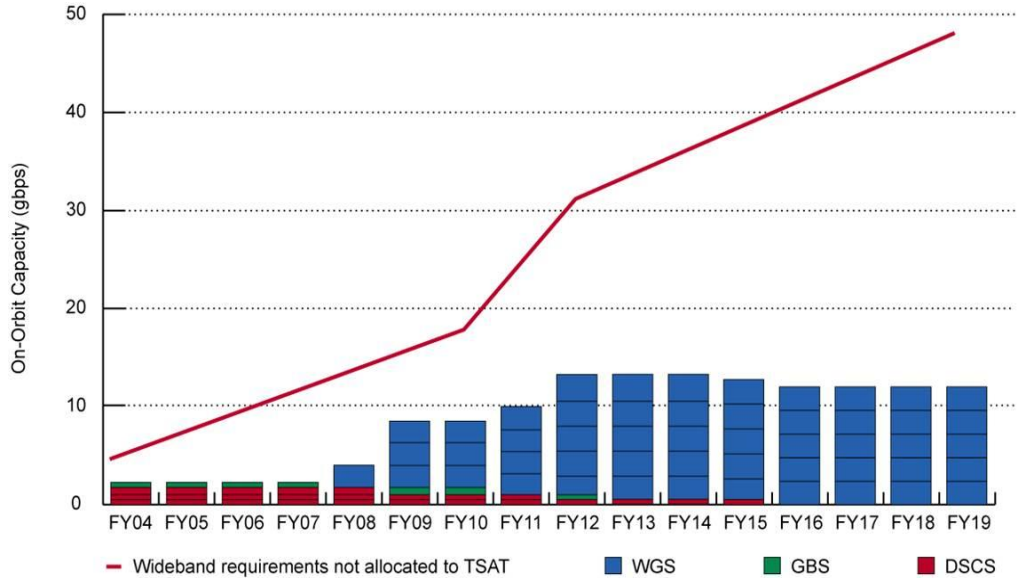

Figure 3. Capacity Projections for Unclassified Military Satellite Communications Programs. (Reprinted from briefing, David Cavossa, Satellite Industry Association, subject: Satellite Industry Overview and Lessons Learned, 26 September 2007)[20]

ASSESSING OPTIONS

One option is to accept the current dependence on commercial satellite communications capability. To meet demands, the US Air Force and its sister services have taken advantage of the prolific commercial satellite communications sector. The DoD has put vast amounts of resources into capturing some of the capability commercial vendors put on the market. The estimates, consistent in both government and industry sources, are that the DoD is spending nearly $500 million a year on commercial leases.[21] The concerns with this option were a significant topic at the 2008 Satellite and Content Delivery Conference.

The military and commercial environments and their interaction were the focus of the conference. At the conference, US Air Force Brigadier General Michael Carey noted the concern with the ability and willingness of commercial satellite communications providers to reach the remote regions of the world. His perspective was "nobody knows and we need to know that we can count on quick response for our communications."[22] Intelsat General's President, Kay Sears, commented on the flexibility to quickly alter end-to-end connections, but there was no discussion in the research on the ability and willingness to transit communications satellites if required. In addition to the concern over the responsiveness of commercial vendors, conference attendees discussed the concern that the military is over-dependent on the commercial sector. Military representatives at the conference addressed two perspectives. One position presented was that the US military needs to reduce the use of commercial satellites and another was that any reduction is unnecessary. The latter emphasized that the commercial vendors can provide the necessary security demanded by the military. The former was less sure of the commercial sectors ability to secure capability and position itself anywhere the US

military required capability.[23] Even if possible, there is concern that it may not be at an affordable price.

Both the RAND Corporation and the US GAO looked at DoD investment in communications satellites. In 2000, RAND recognized the capacity gap already discussed above and agreed the US military must obtain some capacity from commercial providers;[24] however, obtaining commercial capability has had its issues. In 2003, US GAO inspectors noted concern with multiple military customers and little or no effort to combine requirements to garner a bigger lease and resource savings. In 2005, the inspectors provided an update to Congress and indicated the DoD, in response to oversight pressures, was taking steps to adequately define requirements and efficiently lease services.[25] As time has advanced, the US Air Force improved by more centrally managing requirements and combining where possible to drive better leases. A constraint to doing this at a department level is the management of funding. In 2009, the author was involved in an US Air Force lease of commercial satellite bandwidth. The US Air Force centralized requirements, in line with US GAO recommendations, and relayed these to the joint warfighting command, while the other armed services were doing the same. However, the joint warfighting command could not centrally process and prioritize these requirements because the money and decision-making rested with each of the armed services.

An important related question addressed in the RAND report was whether the DoD could spend less if it acquired military owned and operated capability for operations or spend less if it leased commercial services as needed. Considering the leasing practices of the time, RAND established an evaluation tool to show expected costs to meet or exceed demands independently or combined with commercial leases. The RAND summation was "the cumulative cost to the government is lowest when DoD obtains the equivalent of between 60 and 80 percent more

[military] capacity than it needs to satisfy [existing] day-to-day demand."[26] In general, this means the US military acquiring enough military owned capability to meet day-to-day needs, plus significant extra military owned capability for contingencies and leasing only a limited amount of bandwidth from commercial providers as needed, would be less expensive than acquiring any other combination of military owned and commercially leased capability.

A second option is obviously less communications via space. A number of authors have suggested that, if the DoD and the US Air Force have become so dependent on space assets, the military should reduce its dependence.[27] The US Air Force can seek other transport media to provide the bandwidth used to support operations. However, no alternative is without risk.

A significant contributor of bandwidth for US Air Force operations is fiber-optic lines traversing the globe. Fiber optic media, however, does not have the flexibility to meet the needs of a fluid military force with multiple and varying communications devices.[28] First, the fiber optic media must be available. Often, in the austere locations military forces operate in, there simply is none. Wherever fiber optic capability does exist, there are still physical risks, even miles and miles away. Technology forums have highlighted the bottleneck of fiber optic services running through key points on the globe that, if disrupted, could impact capability globally.

In late 2006, an undersea earthquake near Taiwan severed or damaged eight undersea cables, disrupting communications across the entire Pacific Rim.[29] In 2009, Typhoon Morakat damaged seven cables in the same region, interrupting voice and data lines for a significant amount of time.[30] Multiple simultaneous undersea fiber optic cable cuts significantly impacted Egypt and India on more than one occasion in the last two years. One multi-cut event reduced bandwidth in India by 50 to 60 percent and reduced Egyptian network capability by 70 percent.[31]

Such a loss of capability in support of military operations would severely impact command and control and could be fatal.

Other emerging technologies may also help reduce dependence on satellite communications, such as high-altitude aircraft, near-space aircraft, and high-altitude balloons. However, most are still in research or development and not ready for an operational environment, and like satellites, each has benefits and challenges. The general advantages are reduced cost for the platforms and greater ability to recover and repair. The greatest disadvantages to any alternative is the inability of these platforms to be overhead continuously and the necessity of a ground-based support airfield in the region where employed. Even if the US Air Force were to adopt these technologies, a high degree of risk would remain to both assets and Airmen having to deploy. Additional research and development is needed may reduce these concerns in the future.

A third option for consideration is to grow the amount of US military satellite communications capability. In the contested environment of space, ownership is a key factor, providing decision-making freedom to military leaders they will not have with commercial leases. Recently, in a speech to the Air Force Association Global Warfare Symposium, the commander of the US Air Force's Space Command, General C. Robert Kehler, emphasized a drive to fulfill current programs and stated, "It's always faster to take something you have and make it do something you need."[32] Leaders may want to consider not only fulfilling, but also expanding, current programs. As discussed above, RAND presented a model that suggested the US military could acquire significant military capability at a volume that would lead to lower cumulative cost for capability.

Significant existing programs are or have reached their end of life. First, the Defense Satellite Communications System (DSCS) remains the prominent capability for the US Government. This system provides secure, hardened capability globally. The constellation is nearing its end of life, and a number of the satellites have already exceeded the expected life span. Second, the Military Strategic, Tactical and Relay System (MILSTAR) provides the most secure and reliable current capability to the US Government. The constellation provides global interagency connectivity, securing and routing communications as needed to eliminate ground-based routing and reduce chances of interception. The US Air Force launched the last satellite in this constellation in 2003.

Both programs discussed above have follow-on programs slated to fill the requirements currently met by these programs. The US Air Force has plans for the Wideband Global Satellite (WGS) Communications System to fill the requirements the Defense Satellite Communications System currently meets.[33] According to the deputy program manager for Wideband Global Satellite System, "One WGS satellite's capability is equivalent to the entire DSCS constellation."[34] In this program, the US Air Force has encountered both cost overruns and delays. The Advanced Extremely High Frequency (AEHF) System is the joint-service system follow-on to MILSTAR. This system will provide between 10 to 100 times more bandwidth than the system it will replace. Unfortunately, this program is also behind schedule and even more over projected cost. One article suggests the new launch date for the first satellite will be late 2010, versus 2007 as originally planned.[35]

The US Navy manages the Ultra High Frequency Follow-on and its successor. The Ultra High Frequency Follow-on provides primarily mobile communications capability at sea and on the ground. The life of the satellites in this program has been much better than planned, which

has eased some of the concern with the fielding of its successor, the Mobile User Objective System. The continued success of the Ultra High Frequency Follow-on program and budget constraints have redirected funding of the Mobile User Objective System to other DoD and US Navy priorities.[36]

Costs of satellites and supporting systems will be dependent on system requirements, the maturing of technology, and the abilities of the contractors. The reality of a resource-constrained environment has taken its toll on a significant military satellite communications program. Recently, the Secretary of Defense cancelled the Transformation Satellite System. This system would have put revolutionary communications capability into space, but the program proved to be too expensive. In a published comment, the Chief of Staff of the Air Force agreed with the Secretary that it was too expensive and, to paraphrase, the US Air Force could get two satellites that can still do the job for the price of one Transformation Satellite.[37]

In 2007, Major Benjamin Forest, a Naval Postgraduate School student, provided a tool for quickly assessing current and pending military capability. In his research, Forest provided a brief overview of existing programs, displayed in Table 1 below.

	Deactivated	On-Orbit	Near-Term	Long-Term
Protected	AFSATCOM	Milsar	AEHF	TSAT*
Wideband	DSCS II	DSCS III, GBS	WGS	TSAT*
Narrowband	FLTSATCOM	UFO	MUOS	MUOS

Table 1. Military Satellite Communications Programs (*Asterisks added to identify cancelled Transformation Satellite System program. Adapted from Major Benjamin D. Forest, *An Analysis of Military Use of Commercial Satellite Communications*, 25.)[38]

Forest categorized the programs into protected, wideband, or narrowband communications capability. These categories are not relevant to the arguments in this paper; however, the

important aspect is the relationships of one program to another in regards to follow-on programs in the near or far term. As the planned programs continue to encounter delays in development and fielding, the on-orbit systems approach or exceed scheduled end of life and the risk of failure for the aging systems grows. Taking cancellation of the Transformation Satellite System into account, there is now an exacerbated gap in long-term military capability. One can expect the commercial sector to be able to help support wideband requirements, but it does not appear likely the commercial sector can support protected requirements.[39] The military requires an organic capability or the ratio of commercial to military provided bandwidth will only swing more to the commercial sector. The table highlights both the lack of capability and the need for the US Air Force to continue to critically assess how systems are programmed and acquired.

The US military is also working to improve acquisitions of satellites for organic capability. General Kehler is advocating for better processes. "With continued concerns over cost, schedule and performance, Air Force Space Command will require new approaches to rapidly produce the capabilities."[40] The US Government Accountability Office continues to keep an eye on the improvements the services make. The benefit can be increased trust from Congress and DoD leadership, and, in turn, necessary funds for military owned and operated satellite capability.

This third option provides both the flexibility of commercially available leasing and the security and responsiveness of military owned capability. Reducing the 80% volume of bandwidth obtained from commercial services and increasing the amount of military owned bandwidth can reduce overall costs, in addition to overcoming any impacting commercial business practices and decisions. Military leaders will have more assets they are able to immediate able to command and control in support of contingencies.

RECOMMENDATIONS

We're going to have to be responsible to the needs of Combatant Commanders and other national users who may be engaged across the spectrum of conflict or in non-military contingencies, and maybe both at the same time, at any time.

- *General C. Robert Kehler*[41]
  Commander, Air Force Space Command
  31 March 2009 speech

Strategic guidance calls on all services to optimize capability and mitigate risk. The US Air Force Space & C4ISR CONOPS calls for a redundant and sustainable space capability "for seamless information exchange."[42] In addition, President Bush emphasized in the 2006 National Security Strategy the DoD and the Air Force must "better balance its capabilities" to overcome "disruptive challenges."[43] If decision makers accept the available bandwidth will never surpass warfighter's demands, then the Air Force must not simply seek quantity, but prioritize needs, optimize supply, and better address risk. Current US plans involve both commercial and military capability. Both inter-theater and intra-theater connectivity is supported by fiber-optic systems, commercial satellite systems, and military satellite systems. It is ideal for the US Air Force to continue to multiple communications paths. As an Air Force space historian noted, projections show that meeting future demands will "necessitate a strategically well planned ... combination of dedicated and commercial capabilities."[44] What capability can and will be available is an important consideration. Plans that better balance the availability of military capability and commercial capability is the important end. As noted previously, military capacity is lacking. Looking back at Figure 3, the current information shows that this capability gap will exist even when current plans are considered.

To mitigate risk to extremely critical command and control capability, the US Air Force must better balance investments in commercial and military communications satellites. At a

minimum, the US Air Force, likely in conjunction with the rest of the DoD, should bring together enough military satellite communications capability to mitigate the loss of any needed terrestrial- or space-based capability. Costs of commercial capability may exceed US Air Force budgets. Other media, such as fiber optics, will not reach the austere environments where the US military will fight. Having organic capability, to include organic reserve capability, gives the US Air Force the flexibility needed to fight through the loss of other services and mitigate the risk to operations. The RAND study showed that acquiring reserve capability could lower cumulative costs.

The US Air Force must invest more in military communications satellites to better balance commercial and military capability. Be it increasing current programs or seeking a more off-the-shelf form of satellite acquisition, the mitigation of risks justifies costs. The DoD has looked at the arguments for and against before. In 1962, then Secretary of Defense Robert McNamara cancelled plans for military communications based on his position that the military could lease less-costly services from commercial service providers. In the end, US leadership realized the need for dedicated military communications satellites to satisfy many of the unique requirements, such as stationing, security, and survivability.[45] In their 2000 publication, *Wideband Investment Options for the Department of Defense*, RAND agreed and concluded the US should invest in more organic capability, citing the same unique requirements.[46] However, to be clear, neither RAND nor this author considers excluding the commercial sector for bandwidth and other services. A significant factor in gaining needed capability will be improvements in the acquisition process.

As a means to improve acquisitions and expenditures, the US Air Force should consider offering some degree of commercialization with acquired satellites. Other nations have aided

their military satellite communications programs in different ways. Spain has launched satellites with both commercial and military capability. The United Kingdom has contracted out satellite capability with agreements to afford the supporting commercial vendor opportunity to lease services.[47] The US Air Force has stepped up to allow Australia to fund the US Air Force's sixth Wideband Global Satellite in exchange for access to capability by the Australian military.[48] This "strategic approach" to satellite acquisition can strengthen planning, requirements, and standards of future capability.[49]

CONCLUSION

"Above all other communities, the military needs to understand implications of space as a contested environment and how to protect America's interests."

- *Colonel Sean D. McClung*[50]
  Director, National Space Studies Center
  Air University Public Affairs Interview

The demand for bandwidth to support operations is great and increasing. Advances in information technology and growing numbers of remotely piloted vehicles continue to drive up demand. Expectations are this growth will continue into the future. Space, as we see it today, will never meet the demands for bandwidth, so the DoD and the US Air Force must optimize supply. The intent of this discussion is to show that more military satellite communications capability is necessary to meet needs and mitigate risks. In the contested environment of space, ownership is a key factor in having what you need when you need it. To mitigate risk to this extremely critical capability, the US Air Force must better balance investments in commercial and military satellite communications.

In our fiscally constrained environment, the relative cost of military versus commercial capability is important, and both will require large investments. Expanding current military programs and building reserve capability can meet the needed balance without increasing overall costs. The US Air Force can take advantage of the increasing efficiencies of acquisitions in satellite programs to obtain the needed organic capability with greater confidence, strengthening the US satellite industry and giving the US military the bandwidth and flexibility needed to fight tomorrow's wars.

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[4] *Futron's 2009 Space Competitiveness Index*, 66.
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[8] R. Cargill Hall and Robert Butterworth, *Military Space and National Policy: Record and Interpretation*, 16.
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